Construction of the Superconducting ECR Ion Source VENUS

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The superconducting ECR ion source (ECRIS) VENUS, whose R&D progress has been previously documented [1,2], is presently beginning its construction phase. The VENUS project aims for following significant improvements for ECRIS:

1. Reach the highest magnetic fields so far obtained in an ECRIS to improve plasma confinement.
2. Utilize a commercially available 10kW-CW 28 GHz gyrotron amplifier to take advantage of the high magnetic fields and the large plasma volume.
3. Develop new clamping schemes for the superconducting coils in order to withstand the strong magnetic forces.
4. Use state of the art cryogenic equipment, utilizing cryocoolers and High Tc leads, to eliminate the need of a liquid-He filling system.
5. Develop a cold mass suspension system, which can withstand the strong magnetic forces that occur in ECRIS designs and simultaneously maintain a low heat leak to allow the use of cryocoolers.
6. Develop a miniature high-temperature oven (~2000 deg. C) to be axially inserted into the ion source.

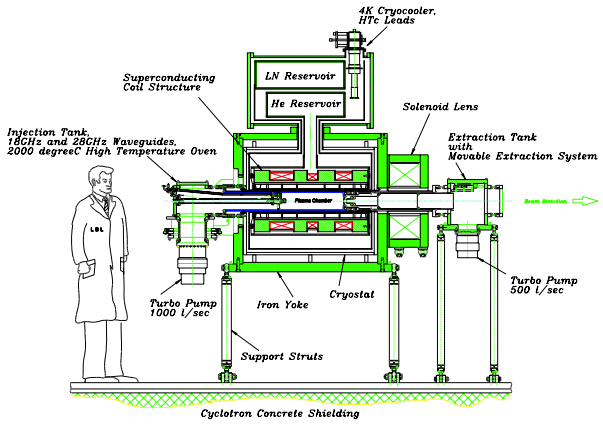

Fig. 1. Section view of the VENUS ion source.

7. Develop a thin walled aluminum plasma chamber, which allows sufficient cooling of the walls and maintains a maximum plasma volume.
8. Increase the electrical insulation capability of the source in order to facilitate operation at higher extraction voltages.
9. Develop a beam extraction and analyzing system, which can transport the higher expected beam intensities. The high magnetic field (up to 3 T) of the extraction region results in different focusing properties for different ions thus requiring a versatile transport system.

In order to demonstrate these technology advancements some VENUS design parameters are compared with the respective parameters of the two existing LBL ECR ion sources [3] in table 1.

	ECR	AECR	VENUS
Magnetic Field: [Ampere-Turns]	231,000	317,000	3,000,000
Magnetic Field: [Peak Field]	0.4 T	1.7 T	4 T
Microwave: [Frequency]	6.4 GHz	10 GHz + 14 GHz	18 GHz + 28 GHz
Microwave: [Total Power]	600 W	2,600 W	14,000 W
Extraction: [High Voltage]	10 kV	15 kV	30 kV

Table 1: Comparison between LBNL ECR Sources.

References

[1] Lyneis, C.M., Z.Q. Xie, and C.E. Taylor, Review of Scientific Instruments 69(2), 682 (1998).

[2] Leitner, M.A., et al., Proceedings of the 14th International Workshop on ECR Sources (ECRIS'99), CERN, Geneva, Switzerland, May 3-6, 1999, p. 66.

[3] Wutte, D., M.A. Leitner, and C.M. Lyneis, Proceedings of the European Particle Accelerator Conference (EPAC 2000), Vienna, Austria, June 26-30, 2000.